Effect of steam saturated atmosphere on some physical and mechanical properties of poplar wood

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Final Cost Action FP0904 Conference

"Recent Advances in the Field of TH and THM Wood Treatment"

May 19-21, 2014, Skellefteå, Sweden

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Book of Abstracts

Organized By:

- **Luleå University of Technology, Skellefteå,**
- **Division of Wood Technology and**
- **COST Action FP0904**
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Preface

Book of abstracts includes the scientific program and the abstracts of papers will be presented at the Final COST Action FP0904 Conference on "**Recent Advances in the Field of TH and THM Wood Treatment**" at the **Luleå University of Technology**, Division of Wood Science and Engineering, in Skellefteå, Sweden on 19–21 May 2014.

The main objective of COST Action FP0904 is to achieve a better understanding on mechanical and chemical transformations of wood during Thermo-Hydrous (TH)/ Thermo-Hydro-Mechanical (THM) processing through collaborations between different researchers from the wood and material sciences. This Action provides cooperation and encourages research between research groups from academia and industry to help to overcome the challenges in scaling-up research findings, improving full industrial production, process improvement, in understanding the relations between the processing parameters, material properties and the development of new products. The COST Action FP0904 consists of three Working Groups (WGs):

WG1: Identification of chemical degradation of wood under Thermo- Hydrous treatment
WG2: Modelling of Thermo-Hydro-Mechanical behaviour of wood during processing
WG3: Innovation and new products by Thermo-Hydro-Mechanical processing

We wish the conference provides a forum and an opportunity for experts and young researchers from worldwide academia and industry to present their latest research, exchanging and developing new ideas within the field of TH and THM wood treatment. The objectives of this conference are to present and discuss the state-of–the-art of TH/THM wood treatment in open and closed systems and the challenges in wood characterization and scaling-up from laboratory to full industrial production, through a discussion of the latest research results and new ideas. The key objective of this Final Action FP0904 Conference is to present the main results of the Action, to summarise the scientific progress achieved and to formulate open questions and further challenges. This conference will include an evaluation session with representatives of COST and Action Management Committee members.

Luleå University of Technolgy (LTU), established in 1971, is the northernmost University of Technology in Scandinavia and is known for its education and research within the field Wood Science and Engineering. The research area of Wood Technology, Wood Physics and Wood Products Engineering is since 1982 established in the city of Skellefteå. Northern Sweden is one of the most important areas in Europe when it comes to forestry and the wood industry. The Wood Science and Engineering group at LTU are engaged in a wide range of fields within the entire chain from forest to finished product.

On behalf of the COST Action FP0904 Management Committee I would like to thank everybody that kindly contributed to this meeting: all the authors and specially the keynote speakers; Callum Hill, Eiichi Obataya, Otto Th. Eggert and Kevin Candelier.
I gratefully acknowledge the help of the Scientific Advisory Committee in reviewing the abstracts and preparing the scientific program.
I express my sincere gratitude to Dick Sandberg and Mojgan Vasiri for their works in preparing the "book of abstracts" and also as the local organizer.

Parviz Navi
Chair of COST Action FP0904

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DATE	18-21 MAY
VENUE	Arenan at Campus Skellefteå
OFFICIAL LANGUAGE	The official conference language will be English.
BADGE	Delegates must report to the registration desk to collect their name badges and conference materials. Every participant including his/her accompanying person is requested to wear a name badge during theconference period. Venue **:** Lobby Arenan The desk will also be operating during the following schedule
REGISTRATION	18 May Sunday 14:00-16:30
RECEPTION DESK	18 May Sunday 14:00-16:30 19 May Monday 07:20-11:30 20 May Tuesday 08:00-08:40 21 May Wednesday 07:30-11:00
SPEAKER'S RECEPTION DESK	Regarding Oral Presentations, please note that: It is expected that all presentations will be presented in English using Microsoft PowerPoint with a common computer provided by the conference organizers. We encourage you to check your PowerPoint file compatibility in advance. An overhead projector will be available by special request. **IMPORTANT!** All speakers are required to check in at the Speaker's Reception Desk by 18 & 19 May in order to hand over the CD or USB with the PowerPoint file, to be downloaded on the conference computer. All speakers during Tuesday **must** hand in their presentations during Monday May 19. The opening times for the Speaker's Reception Desk are the same as for the Information Des, Sunday 14:00-16:30 and Monday 7:20-11:30. During Tuesday and Wednesday only by request in advance, (please contact the General Information Desk for further assistance)

Time	SUNDAY MAY 18	Time	MONDAY MAY 19	Time	TUESDAY MAY 20	Time	WEDNESDAY MAY 21
		07:20-08:20	Registration	09:00-9:30	**Session 3**: New products by THM-open system **Keynote 3: Otto Th. Eggert**	08:00-08:30	Coffee
		08:20-08:40	Opening session	09:30-10:30	3 Full Oral Presentations	08:30-10:30	Management Committee Meeting and the Evaluation Panel (Closed session)
		08:40-09:20	**Session 1**: Chemical degradation of wood under thermo-hydrous treatments **Keynote 1: Callum Hill**	10:30-11:00	Coffee Break		
		09:20-10:00	2 Full Oral Presentations	11:00-11:40	2 Full Oral Presentations		
		10:00-10:30	Coffee Break	11:40-12:00	5 Poster Presentations		
		10:30-11:10	2 Full Oral Presentations	12:00-13:30	Lunch		
		11:10-11:30	6 Poster Presentations	13:30-14:10	**Session 4:** Innovations and new products laboratory and industrial scale & STSM presentations **Keynote 4: Kévin Candelier**		
		11:30-13:00	Lunch	14:10-15:10	3 Full Oral Presentations		
		13:00-13:40	**Session 2**: Modeling of THM processing and predicting the behavior of THM **Keynote 2: Eiichi Obataya**	15:10-15:40	Coffee Break		
		13:40-14:20	2 Full Oral Presentations	15:40-17:18	8 Oral Presentations & 2 Poster Presentations		
		14:20-14:50	Coffee Break	19:00-22:00	Conference Dinner		
14:00-18:30	Registration And Welcome Reception	14:50-15:50	3 Full Oral Presentations				
		15:50-16:13	7 Poster Presentations				
		16:15-18:00	Posters & Visit To LTU Laboratory				

	SUNDAY **MAY 18TH**
14:00-18:30	**Registration And Welcome Rception**
	MONDAY **MAY 19TH**
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WEDNESDAY MAY 21TH	
08:00-08:30	Coffee
8:30-10:30	Management committee meeting with the COST representative and the evaluation panel (Closed Session)

Abstracts

Effect of steam saturated atmosphere on some physical and mechanical properties of poplar wood

Lorenzo Barnini, Giacomo Goli, Marco Fioravanti

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Keywords: thermal treatment, saturated steam

Poplar wood is a specie that is and it was widely used in Italy as solid timber or, more recently, as a part of wood-engineered products. Many important Italian heritage objects (e.g. panel paintings, wooden sculptures, old timber structures) were made in poplar. According to recent studies [1], now days the yearly need of poplar wood in Italy is around $3.9 \cdot 10^6$ m^3 from whom about one half are home grown.

Because poplar wood is very suitable for applications where the lightness is essential such as for the caravan sector, where the wood durability is essential as well, a research was planned in order to understand 1) the effects of the hydro-thermal (HT) treatment on modification of some poplar wood properties, and 2) for studying the suitability of HT as a means for producing artificial accelerated ageing of wood to be used in the restoration of wooden Cultural Heritage.

In this work, the effect of HT treatments in saturated moisture conditions is studied and the treatments was performed according to the experimental protocol presented in Table 1.

Table 1. *Experimental matrix and main results in terms of colour variation (ΔE), mass variation (ΔMASS), MOE variation (ΔMOE) and moisture content variation (ΔMC) at standard environmental conditions (20°C and 65% RH) after hydro thermal treatment in saturated vapour conditions for the given temperatures and treatment periods*

	1h	2h	3h	6h	12h
100°C			4,90 -0,9% 2,2% -0,47%	5,72 -1,3% -0,4% -0,49%	
120°C			8,30 -1,6% 2,1% -1,01%	11,15 -2,2% 1,3% -0,96%	15,62 -2,3% 3,4% -0,97%
140°C		15,27 -2,9% 4,7% -1,30%	17,04 -3,6% 9,4% -1,40%	21,96 -4,5% 2,3% -2,11%	
150°C	17,00 -3,4% 7,4% -1,59%		28,83 -7,4% -5,7% -3,43%		ΔE ΔMASS ΔMOE ΔMC

Different samples of poplar wood (*Populus x euroamericana* Guinier) were prepared from the same board after a first cut by cleavage. The properties variations were determined as the difference between the treated and untreated state (20°C and 65% RH) and referred to the untreated state. The properties variations were studied on: colour, mass, MOE and moisture content. All these features, except the moisture content which is compared to a reference sample, were measured as a variation on the same specimens. The measurement of the colour was performed according to the CIE L*a*b* 1976 definitions and by a Konica-Minolta mod. CM700d colorimeter. The MOE was measured by a tensile test on small samples (8x3x150 mm) up to a 30% of ultimate load. Qualitative chemical analyses of the samples were performed by FTIR after extraction in Soxhlet as from the method defined by [3]. In Figure 1 is reported the mass variation for different temperatures and periods of treatment.

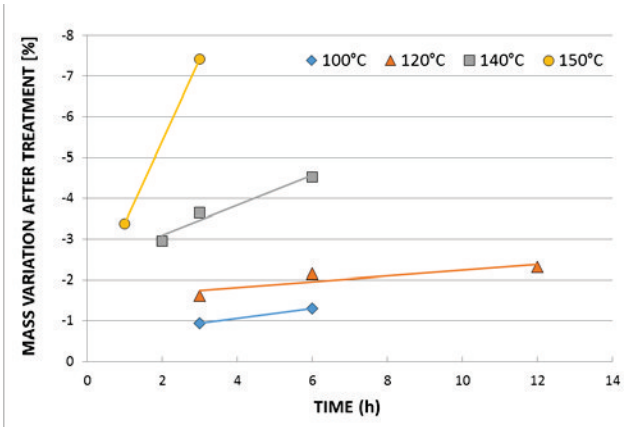

Figure 1. Mass variation as a percentage of the initial mass vs. time for different treatment temperatures and periods

The mass losses are clearly depending on the treatment intensity and the reaction kinetics in saturated steam is very fast if compared to treatments performed for similar temperatures in conventional oven [2]. A mass loss of 8% (at 20°C and 65% RH equilibrium state) in the former case is attained after 3 hours of treatment at 150°C while in the latter after about 20 hours at 180°C. The equilibrium moisture content variation at 20°C and 65% RH result in the same trend than mass loss. The volume have shown an opposite behaviour if compare to oven treatments and result increased. The colour variations present trends in line with the mass loss. MOE show a tendency to increase up to 10% until a mass loss of 4% is attained. For larger mass losses MOE tends to reduce again getting to the same value of untreated samples at 5%. For higher mass losses MOE gets again to lower values if compared to untreated samples. From a chemical point of view results shown that a significant loss of glucoxylans starts after 6 hours of treatments at 100°C, and they completely disappear at 120°C for 12 hours, 140°C for 6 hours or 150°C for 1 hour. The other wood components do not seem to be very affected by the treatment.

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3. TAPPI T 264 cm-07, 2007

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